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enlightened courtesy is unfortunately too rare in this country, perhaps especially amongst schoolboys, in whom an insufferable "insularism" takes the place of patriotism.

But, whether English or foreign, nearly perfect or sadly deficient, the governess has a right to expect that the employers will uphold her prestige and authority over her pupils; if her peculiarities make this impossible, they will do better to give her place to another, for children cannot submit to a divided authority. If she should commit pardonable errors, they should be pointed out to her in private, never before the children. Parents should never, on any account, allow children to criticise their governess or to laugh at her; the little ones need not be discouraged however from relating small incidents to their mother if they wish it; the mother should appear convinced that the governess herself would not have the slightest objection to this.

The parents and the governess need have no false shame in acknowledging their business relationship before the children, for it is inconceivable that children whose father works to support them should consider it a dishonour for a woman to receive a well-deserved salary for her pains; parents capable of humiliating a gentlewoman on that score wish for no advice and would follow none. As it has already been said, parents so completely devoid of manners must be let alone or taken as they are, and it would be a mistake on the part of the governess to allow every little pin-prick to hurt her. If good reasons induce her to remain with them, she should meet them with an indifference made of some contempt, perhaps, and a great deal of pity—they sin through sheer ignorance.

A well-bred mother who is desirous of bringing her children up to become refined men and women, will choose a well-bred girl for their governess, and will treat her as such, with as much consideration as they would show to a guest; the governess' comfort will be attended to, she will be given a pretty, bright bedroom, which she can look upon as her own, and fill with her own belongings; in the country, she may keep pets of her own or have a little garden to cultivate. Her health will be cared for, books will be lent to her, in short, every attempt will be made to make her happy. Such thoughtfulness will be attended with unfailing success in a household where peace and love already reign; all the theories in the world cannot take their place.

THE TRIUMPH OF DECIMALS.

By Henry Clarke, M.A.

Slowly but surely we are advancing towards the decimalisation of our money, weights and measures. A Decimal Association has been formed and is active. A system of coinage has been devised which leaves the British sovereign and the British florin unchanged. The use of the metric system of weights and measures has been rendered legal by Act of Parliament (27 and 28 Vict. cap. 117, 29th July, 1864), and a knowledge of this system is now required of candidates at all professional examinations and of children in the higher standards of our elememtary schools. From a recent report of the Board of Trade we learn that the Standards Department, not unmindful of Horace's sage advice—

> "Segnius irritant animos demissa per aurem,
> Quam quae sunt oculis subjecta fidelibus,"

have in course of preparation, for the purpose of explaining the principles of the metric system in schools, a set of educational models of metric weights, measures, and weighing and measuring instruments similar to those used in trade. Lastly, at the suggestion of the Associated Chambers of Commerce, Lord Salisbury recently requested our representatives in the chief European capitals to report on the working of the metric system, and it is gratifying to the advocates of reform in this country to learn that in France, Germany, and Austria the working of the system is entirely satisfactory and that there is not the smallest desire to revert to the more cumbersome systems formerly employed. In view of these facts it seems clear that, in spite of the opposition of ultra-conservatives, and in spite of pathetic letters to the *Times* on the sub-multiples of 12, we shall before long fling aside our cumbrous coinage, our cumbrous weights, and our cumbrous measures, and at length fall into line with the rest of the civilised world.

The moment, then, seems opportune for an attempt at a forecast of the effect of this important change on the teaching of arithmetic in schools. The first and most obvious effect is one that will fill the heart of every schoolboy with joy, for it amounts to nothing less than the abolition of tables. Of course there will still be tables of a sort, but these will be so transparently easy that the great burden may be said without exaggeration to have fallen for ever from the back of British boyhood. Those of us who can recall our early days will sympathise heartily with the happier members of a new generation. I myself am not ashamed to confess that I never had the capacity to master "dry" measure, and that my acquaintance with "wine" and "beer" measure is of the haziest description. Even the multiplication table will be shorn of half its terrors. The rigid decimalist will tell us that if we go *one* step beyond "9 times 9" there is no reason why we should stop *anywhere*; and the logic is so cogent and the prospect of a multiplication table extending *ad infinitum* is so alarming that we shall thankfully acquiesce in a table that begins with "0 times 0" and ends with "9 times 9."

There will be no difficulty in filling up the time formerly spent in drearily saying tables. For in spite of recent improvements in the teaching of arithmetic there is one part of the subject which has not received from teachers the attention that it deserves, and this part is the most elementary stage of all. The reason is not far to seek. Boys come to our preparatory schools already able to perform the fundamental operations of arithmetic, having acquired this ability by the methods—best described as individual—which prevail among nursery governesses, mothers' helps, *et hoc genus omne*, and their masters prefer to devote their energies to the teaching of the higher rules rather than to unteach and reteach what has been already mastered. I venture to suggest that the first four rules may be so taught as to be at once a better mental discipline and a more interesting study than is at present the case.

Into the question whether we ought to begin counting at "0" or at "1," I do not propose to enter. What I would insist upon is that a child should be allowed to begin counting where he pleases, and to count as far as he likes both ways. To the objection that this necessitates a very early introduction of the minus sign, I would reply that in my opinion the use of the minus sign cannot be advantageously postponed to a later stage. To our imaginative little ones, who are quite at home in fairy-land, fable-land and wonder-land, it must seem perfectly natural to count backwards indefinitely just as they count forward indefinitely. All they want is a suitable nomenclature, which can easily be supplied by the use of the word minus (abbreviated for practical reasons to mĭn.). This method of counting: 3, 2, 1, 0, mĭn. 1, mĭn. 2, mĭn. 3, etc., may be usefully illustrated by reference to a Centigrade thermometer.

After sufficient practice in this continuous addition of 1 and continuous subtraction of 1, the fundamental facts of the decimal system of numeration should be explained and tabulated thus:

10 ones make 1 ten
10 tens make 1 hundred

etc., etc.

At this point another appeal may be made to the child's imagination and he may be told in reply to, or in anticipation of, his questions that the name "tenth" is given to that of which 10 make 1 "one," "hundredth" to that of which 10 make 1 "tenth," etc., thus:

10 tenths make 1 one
10 hundredths make 1 tenth

etc., etc.

This nomenclature is open to the serious objection that the words "hundred," "thousand," etc., do not convey the slightest intimation, except perhaps to

> "Those learn'd philologists who chase
> A panting syllable through time and space,"

of the relation in which they stand to the radix of the system, *i.e.*, to the number ten.

By writing, however, "ten tens" for "hundred" (cf., the Gothic *taihun-taihund*), "ten ten tens," for "thousand," etc., we are led up quite simply to the notion of a power and we may write

10^3 = 1 thousand
10^2 = 1 hundred.

From this follows, by the above explained method of counting backwards, that

10^1 1 ten
10^0 = 1 one
10^{-1} = 1 tenth
10^{-2} 1 hundredth

etc.

By writing "3th" for Thousand,
"2th" ,, Hundred,
"1th" ,, Ten,
"oth" ,, One,
"mĭn. 1th" ,, Tenth,
"mĭn. 2th" ,, Hundredth,

we obtain a nomenclature admirably suited for intelligent arithmetical work.

The barrier which has hitherto unfortunately separated so-called "decimals" from whole numbers should now be swept away by a clear explanation of the characteristic feature of our method of notation. This is, of course, that when the denomination of any one of a line of digits is known, the denominations of all the others may be inferred from their positions relatively to that one, and that the necessity of marking the denomination of even one digit is in practice obviated by the convention that a point should always separate "oths" from "min. 1ths."

In working examples in addition, subtraction, multiplication and division, the pupil should be made to state explicitly the significance of every step in the processes. Addition and subtraction present no difficulties and the signification of each step in multiplication or division is manifest from an examination of our numeration table. We see from this that any denomination when

multiplied by "1ths" gives the next higher denomination,
,, ,, "2ths" ,, second ,, ,,
,, ,, "3ths" ,, third ,, ,,

and so on; and therefore any denomination when

multiplied by "oths" gives the same denomination,
,, "min. 1ths" ,, next lower ,,
,, "min. 2ths" ,, second lower ,,

and so on.

We see also that any denomination when

divided by "1ths" gives the next lower denomination,
,, "2ths" ,, second ,, ,,
,, "3ths" ,, third ,, ,,

and therefore any denomination when

divided by "oths" gives the same denomination,
,, "min. 1ths" ,, next higher ,,
,, "min. 2ths" ,, second ,, ,,

and so on.

By the application of the above to a carefully graduated series of short multiplications and divisions (i.e., multiplications and divisions by a single significant digit of any denomination) as well as long multiplications and divisions, the pupil may obtain for himself by induction the following important results:—

(1) The sum of the numbers involved in any two denominations gives the number involved in the denomination of their product.

(2) The number involved in the denomination of any quotient figure is equal to the difference obtained by subtracting the number involved in the first division figure from the number involved in the denomination either of the first or of the second figure (as the case may be) of the corresponding dividend.

It should be noticed with reference to these two results that the addition of a min. produces a decrease and the subtraction of a min. produces an increase; also that these results involve in themselves the means of fixing the position of the decimal point without the application of any special "rules for pointing."

Hitherto it has been the prevailing custom to teach "vulgar fractions" before "decimals." Only after much practice in the simplification of fractional expressions of a high order of complexity, and such as would seldom present themselves in practical calculations, has a boy been allowed to begin "decimals," which, as I have attempted to shew above, are best treated as the natural extension of our numeration table. The introduction of decimal systems of money, weights and measures will be the death-blow to this traditional order of study, and only when a boy is perfectly at home in the manipulation of "decimals" will he be allowed to proceed to the systematic study of vulgar fractions. Such expressions as $\frac{4600}{3}$ and $\frac{2}{3}$ will, however, be found useful at an early stage, the former to express the fact that 4600 is to be, but has not yet been, divided by three, the latter to express the fact that 2 cannot be divided by 3 without reduction to the next lower denomination.

Under the new régime "reduction" will be reduced to the mere shifting of a point, and practice to simple multiplication. The very names will probably be as unfamiliar to a new generation of schoolboys as "alligation" and "double position" are to the present.

On the other hand, there are some departments of the subject which will in future receive a far larger share of attention than is at present the case. Some of our text-books of arithmetic altogether ignore "scales of notation," yet no student can be said to have an intelligent knowledge of arithmetic who does not clearly realise that our decimal system is only one of many possible systems.

Again, "contracted methods" of multiplication, division and square root do not at present receive an amount of attention at all commensurate with their importance. Ask the average school boy (and it is the average school boy in whom I am most interested) what contracted methods are, and he will doubtless reply, "It's the chapter in decimals that you can skip." I myself am so far from sharing this view that I should like to see approximations accompany and even precede complete calculations. In practical matters the rough estimate naturally precedes the exact one, and an arithmetically exact result is often practically of no service. Πλέον ἥμιδυ παντός.

Thus in obtaining the product of 1234 and 345 the pupil should first convince himself, by the method explained above, that the digit of highest denomination in the product will either be a "5th" or a "6th." He should then, by the usual method of approximation in multiplication, obtain the first digit; then the first two digits, by a second approximate calculation; and so on, until last of all he obtains the complete product. In division a similar course may be pursued, and it will be found convenient to write over the first digit in the quotient the number involved in its denomination. Even addition and subtraction may be made to supply useful examples of approximations.

The application of approximate methods to arithmetical calculations involving various operations will afford ample scope for thought and ingenuity on the part of the student. It is not necessary to pursue the subject further. It is enough to have pointed out that the coming triumph of decimals will of necessity give to approximations their proper place in the teaching of elementary arithmetic and will render it impossible that Oxford Junior Local examiners should report, as they have done recently, that "Very few candidates appeared to understand what is meant by 'correct to three places of decimals.'"

BIRD WALKS.*

A "BIRD WALK" IN FEBRUARY (NORFOLK).

By S. Hirtzel.

V. and I went out one day to hunt for birds. It was quite warm and sunny and the pines smelt deliciously. We went up the road to a spot appropriately named Pretty Corner. Here there is a heath bordering on a pine-wood, and dotted all about with stunted hawthorns and blackthorns. In an opening surrounded on three sides by the pines it was gloriously warm and one could almost fancy it was summer if it were not for the patches of snow. We came quietly into this place and V. touched my arm, whispering, "What are those birds?" Creeping along under the dead bracken were about a dozen beautiful spotted creatures, like thrushes, peeping out at us with large wide-opened eyes. We went nearer and some of them rose into the air a little way; when they opened their wings in flight they seemed to have a large patch of blood under each wing, as though they had been shot and like Banquo had come back to reproach their slaughterers with their presence. Presently they all entered the wood and we breathed freely again. Just as the red-wings flew off we heard a sound as of scraping glass in the trees close to us. We crept nearer and saw a pert little gold-crest hanging head downwards on a swaying twig, pecking, pecking. Presently he fussed off to another tree and hung there with the sunlight full on his little glengarry-like crest. Away among the trees we heard the harsh warning note of a jay. After watching Master Gold-crest for

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[* These *Bird Walks* (by students of the College), which were shown at the Nature Study Exhibition in August last, illustrate what we aim at in *The House of Education* in Nature Study. We learn to distinguish plant, tree, moss, bird, or what not. As soon as we distinguish we naturally name, and when we know a thing by look, gesture, name, we watch continually and get more and more knowledge of habits and habitat. All this we do for the pure and immeasurable joy of the acquaintances, without any ulterior aim either in the way of scientific or of useful knowledge. We see no object in collections, believing that nature can only be observed *in situ*. Mr. John Burroughs expresses (in a private letter) our feeling on the subject :—"Let those dissect nature who have some special object in view, but let the great mass of young people be inspired with love for living nature in all her forms."—Ed.]